Executive Summary

This Executive Summary presents an overview of the Revised **(JANUARY 2003)** Final Baseline Ecological Risk Assessment (BERA) for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (API/PC/KR) in Southwestern Michigan. The revisions forming the basis of this **(JANUARY 2003)** revised final document address comments[1] on the

- Revised Final BERA (**JANUARY 2002),**
- Final BERA (June 1999), and
- the Addendum to the BERA (August 15, 2000).

KRSG comments were identified in various letters, data summaries, and technical memorandums received by MDEQ from 1999 through late 2001. A July 19, 1999 letter from KRSG to MDEQ contained comments from Giesy Ecotoxicology, Inc.; A September 11, 2000 letter from M.P. Brown to J. Brian von Gunten summarized similar comments. EPA and FWS concerns and comments were identified in several meetings and telephone conversations throughout summer and fall 2000. The Revised (January 2002) Final BERA addressed all the comments presented in these correspondences. An October 11, 2001 transmittal from M.P. Brown (Blasland, Bouck & Lee, INC.) to J.B. von Gunten (Michigan Department of Environmental Quality-Emergency Response Division (MDEQ-ERD) presented a report of the findings-to-date of Dr. J. Giesy's studies of ecological exposure and risks for the site. Concerns and issues presented in the Giesy report have been addressed with this Revised (**JANUARY 2003**) Final BERA.

The primary purpose of this ERA is to identify and describe actual or potential onsite conditions that can result in unacceptable risks to exposed organisms. Sufficient recent site-specific information indicates that this ERA should focus on the primary chemical stressors present at this site – polychlorinated biphenyls (PCBs). This ERA compares measured or estimated PCB concentrations in different types of exposure media (e.g., surface water, sediment, fish) with predicted biological effects to estimate risks and to preliminarily identify appropriate and protective cleanup levels.

Background and Site Description

Due to the PCB contamination, in August 1990 the site was placed on the Superfund or National Priorities List (NPL). The NPL Study Area (API/KR/PC) includes 3 miles of Portage Creek, from Cork Street to its confluence with the Kalamazoo River, and 80 miles of the Kalamazoo River, from Morrow Lake Dam downstream to Lake Michigan. Also included in the site are five paper residual disposal areas and five paper mill properties.

[1] U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS), and the Kalamazoo River Study Group (KRSG)

The Michigan Department of Community Health has issued a species-specific no consumption fish advisory annually since 1977 for the Kalamazoo River portion of this site due to PCB contamination. The Kalamazoo River and Portage Creek have been designated a site of environmental contamination under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA), due to PCB contamination. The Kalamazoo River and Portage Creek have also been identified as an Area of Concern by the International Joint Commission on the Great Lakes due to the detrimental impact the ongoing release of PCBs has on Lake Michigan.

General Approach to ERA

This ERA follows EPA guidance for conducting ERAs, primarily Ecological Risk Assessment Guidance for Superfund (EPA 1997) and Guidelines for Ecological Risk Assessment (EPA 1998). The major components of the ERA include Problem Formulation, Analysis, and Risk Characterization. The Problem Formulation phase of this ERA establishes the goals and describes the scope and focus of the assessment. In addition, this phase considers site-specific regulatory and policy issues and requirements and preliminarily identifies potential stressors and ecological resources potentially at risk. The outcome of Problem Formulation is the site-specific conceptual model, which describes potential exposure pathways and the relationship between remedial action objectives, assessment endpoints, and measurement endpoints. Uncertainties associated with this phase of the ERA are included at the end of this Section.

The Analysis phase of the ERA describes the nature and extent of contamination (Exposure Assessment) and identifies appropriate and relevant threshold concentrations, standards, or criteria for contaminants of concern (Effects Assessment). Uncertainty analysis related to this phase of the ERA is also included.

The final major component of the ERA, Risk Characterization, considers the information gathered in Problem Formulation and integrates Exposure and Effects data to estimate risks to ecological receptors. Also included in Risk Characterization is a discussion of ecological significance, risk summary, and uncertainty analysis.

This ERA also includes an additional section on Remediation Issues in which preliminary risk-based remediation goals (PRGs) are developed.

This ERA uses several lines of evidence to increase confidence in risk estimates and ERA conclusions. These include the use of simple hazard quotients that compare a single selected exposure concentration to a single selected effects concentration to derive a quotient. This is a common screening level approach for identifying issues of most concern. Supplementing this approach is a comparison of multiple media-specific exposure concentrations for specific site locations to multiple effects concentrations that include site-specific and literature-based values. This approach reduces the uncertainties in relying on single exposure and effects concentrations and contributes to the weight-of-evidence. Also included in this ERA is a food chain

model that estimates PCB dose via ingestion pathways for key receptor species or groups. Finally, this ERA considers field observations and other qualitative data as a check on risk estimates and conclusions.

Representative Receptors

Potential ecological receptors for this study are defined as plants and animals that inhabit or use, or have potential to inhabit or use, the aquatic, riparian/wetland, and terrestrial habitats of the API/PC/KR. The large number of potential receptor species identified for the API/PC/KR obviously precludes an assessment of potential risks for every species listed. Several species or groups of organisms have, therefore, been selected to serve as representative receptors for a detailed evaluation of potential risks. These include aquatic plants, aquatic macroinvertebrates, game fish (e.g., smallmouth bass), forage fish (e.g., sucker), rough fish (e.g., carp), terrestrial invertebrates (e.g., earthworms), small burrowing omnivorous mammals (e.g., deer mouse), semi-aquatic herbivorous mammals (e.g., muskrat), small semi-aquatic carnivorous mammals (e.g., mink), and top mammalian and avian predators (e.g., red fox, great horned owl, bald eagle).

ERA-Related Goals and Objectives

ERA-related remedial action goals and objectives for the API/PC/KR have been determined by MDEQ, and include: (1) the establishment and maintenance of a healthy and diverse aquatic and riparian co-systems in and adjacent to the API/PC/KR, and (2) reductions in PCB concentrations in fish and wildlife such that human consumption restrictions can be lifted.

Site Conceptual Model

The site conceptual exposure model (SCEM) is the primary output of the Problem Formulation phase of the ERA, and is used to develop a series of null hypotheses for the API/PC/KR, primarily those regarding potential exposure scenarios and the relationship between selected assessment and measurement endpoints. The null hypotheses for the API/PC/KR are defined as follows:

1. *The levels of contaminants in water, sediment, and biota are not sufficient to adversely affect the structure or function of the fish populations in the Kalamazoo River and Portage Creek System.*

2. *The levels of contaminants in water, sediment, and biota are not sufficient to adversely affect the survival, growth, and reproduction of plant and animal aquatic receptors utilizing the Kalamazoo River and Portage Creek system.*

3. *The levels of contaminants in water, sediment, soil, and biota are not sufficient to adversely affect the survival, growth, and reproduction of mammalian receptors utilizing the Kalamazoo River and Portage Creek system.*

4. *The levels of contaminants in water, sediment, and biota are not sufficient to adversely affect the survival, growth, and reproduction of avian receptors utilizing the Kalamazoo River and Portage Creek system.*

Summary of Conclusions

Hazard Quotient-based Risks

Hazard quotients based on direct toxicity for aquatic biota and dietary dose for other species reveal that mink are at most risk compared to other representative receptors. This preliminary conclusion is supported by multiple lines of evidence described in the ERA.

Overall Risk Summary

Multiple lines of evidence are used to reach the following conclusions.

- Most aquatic biota such as invertebrates and fish are unlikely to be adversely affected by direct contact with and ingestion of surface water because of relatively low PCB toxicity to most aquatic biota. Bioaccumulation of PCBs is not considered at this stage.

- PCB contamination of surface water and streambed sediment is likely to adversely affect sensitive piscivorous predators, such as mink, through consumption of PCB-contaminated prey, especially fish.

  – Impaired reproduction of mink and ultimately decreases in mink populations are the most likely effects of PCB contamination in aquatic prey. There is qualitative evidence that mink populations are declining or are reduced.

  – Other piscivorous predators, such as bald eagles, are at substantial risk based on assumptions about diet (e.g., fish are the predominant prey item consumed) and exposure (e.g., foraging takes place mostly within contaminated aquatic areas). Preliminary data suggest both these assumptions are valid. Field investigations of bald eagles by U.S. Fish and Wildlife suggest there has been a loss of reproductive capacity and decrease in the populations of bald eagles within the site boundaries.

- Terrestrial and semi-aquatic biota may be at risk from PCB-contaminated floodplain sediment and surface soil, depending on life history (e.g., foraging behavior, diet, mobility) and sensitivity to PCBs. Such risk is in general considered to be low to moderate, depending on species.

  – Omnivorous birds (represented by the robin) that consume a substantial amount of soil invertebrates (e.g., earthworms) would be at significant risk if foraging takes place in mostly contaminated areas.

- Carnivorous terrestrial mammals (represented by the red fox) may be at some risk if foraging is concentrated in riparian areas with contaminated floodplain sediment and diet consists of prey that (1) reside in PCB-contaminated areas, and (2) have taken up substantial amounts of PCBs.

- Carnivorous birds (represented by great horned owl) may be at significant risk, depending on diet. Relatively high risks were calculated in association with high PCB concentrations in eggs, while risk estimates generated as a result of food web modeling were comparatively low. Uncertainties with actual diet of great horned owls in the API/PC/KR area and discrepancies between estimated risks to owls, based on the two different methods mentioned previously, cannot be resolved with available data.

- Omnivorous terrestrial species (represented by mice) are unlikely to be at significant risk unless they reside in the most contaminated areas. PCB uptake in mice appears to be relatively low.

- Semi-aquatic herbivorous mammals (represented by muskrat) may be at risk from PCB contamination because estimated dietary doses exceed recommended threshold values for rats. This conclusion is based on the assumption that laboratory rats and muskrats are equally sensitive to PCBs via ingestion. Muskrats contaminated with PCBs may also cause adverse effects to muskrat predators because some muskrats contain PCBs in excess of recommended dietary limits for PCB-sensitive predators such as mink.

This ERA presents overwhelming evidence that, despite uncertainties identified and discussed in the ERA, two and possibly three of the four proposed null hypotheses can be rejected with little reservation.

The first null hypothesis is accepted because there is no direct evidence that fish communities are being affected by PCB contamination. The impaired fish community of Lake Allegan is comprised primarily of stunted and often malformed carp. The cause of these findings cannot be determined from the available data. It is noted, however, that PCBs cause a wasting syndrome in several mammalian species. There is insufficient site-specific data to determine if fish communities in the Kalamazoo River are being directly affected by PCB contamination.

The second null hypothesis is conditionally rejected. This is based on the finding that at some locations the maximum detected surface water PCB concentrations exceed or closely approach the lowest chronic value for freshwater fish or aquatic plants.

The last two null hypotheses are rejected because risks to mammalian (e.g., mink) and avian predators (e.g., bald eagle), especially those that consume fish, are unacceptable. These conclusions are based primarily on the very high levels of PCB concentrations in fish, other biota, and abiotic media (e.g., floodplain sediments).

The ecosystem associated with the API/PC/KR portion of the Kalamazoo River has been and is currently being adversely affected by PCBs originating from past industrial activities. This evidence by the distribution of PCBs in biota at all trophic levels within the API/PC/KR.

Remediation Issues

The selection of the most appropriate methods for achieving remediation goals is not a risk assessment issue but is a risk management issue to be addressed in the feasibility study (FS) for this API/PC/KR. The application of cleanup values is also considered a risk management decision. This risk assessment derives and recommends threshold PCB concentrations ("cleanup values") for each media type. These values are not necessarily intended to be applied to all locations within the API/PC/KR or within a sub-area of the API/PC/KR. For example, it is probably most appropriate to use cleanup values as average media-specific post-remediation concentration goals within a specific area. Alternatively, a cleanup value can be considered a "never to exceed" value for any onsite sample, but such an application might result in needlessly exceeding remediation goals and costs in most areas within the site. It is most appropriate for risk managers rather than risk assessors to decide how to best apply cleanup values recommended in the risk assessment. The proposed cleanup ranges include no effect levels at the lower end and low but significant effect levels at the upper end. These protective PCB ranges for each media type for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site are presented below.

- **Range of protective total PCB concentrations in SURFACE WATER is 0.0016 to 0.00197 µg/L (based on mink, the most sensitive of all animals tested to date).**

- **Range of protective total PCB concentrations in INSTREAM SEDIMENT AND FLOODPLAIN SEDIMENT associated with aquatic or semi-aquatic ecosystems is 0.5 to 0.6 mg/kg (based on mink, the most sensitive of all animals tested to date).**

- **Range of protective total PCB concentrations in SURFACE SOILS AND FLOODPLAIN SEDIMENTS associated with terrestrial ecosystems is 6.5 to 8.1 mg/kg (based on omnivorous songbirds such as robin). To protect carnivorous mammals such as red fox, the range is 5.9 to 29.5 mg/kg.**